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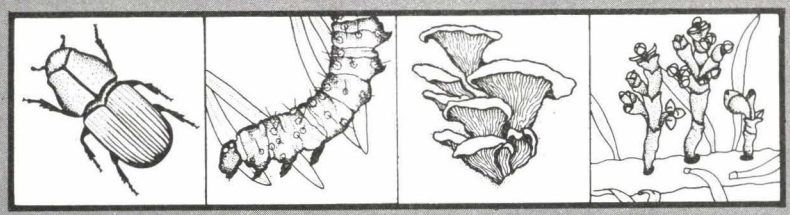
Forest Pest Management



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EVALUATION OF SPRUCE BEETLE
GLACIER VIEW RANGER DISTRICT
FLATHEAD NATIONAL FOREST
1981

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INTRODUCTION

Spruce beetle outbreaks in Engelmann spruce are far less common than outbreaks of bark beetles in other hosts, but do occur periodically following windstorms or other disturbances in the forest. The last major outbreak developed during 1966-67 when spruce beetle killed more than 70 MMBF of Engelmann spruce in the North Fork Flathead River drainage. Additional mortality occurred on the Tally Lake RD, Stillwater State Forest, and in the Ten Lakes Basin, Kootenai NF. A combination of windthrow, logging, overmature stands, and favorable weather conditions released this outbreak which subsided during the winter of 1969-70 from extremely cold temperatures. Since that date, spruce beetle activity has been limited despite periodic windthrow and logging activity.

In August 1981, George Wilson, silviculturist, Glacier View RD, observed extensive areas of spruce discoloration, and newly attacked trees in Coal Creek, Big Creek, Upper Moran, and Cyclone drainages. In addition spruce beetle-infested areas have been located on the Swan Lake RD, Flathead NF; Stillwater State Forest; Murphy Lake RD, Kootenai NF; Glacier NP; and Bonners Ferry RD, Idaho Panhandle NF's.

Wilson requested an examination by Forest Pest Management of the Glacier View RD infested areas. A preliminary ground check verified epidemic populations, and a subsequent biological evaluation was conducted. The objective of this evaluation was to determine current status of what appeared to be a significant bark beetle outbreak in Engelmann spruce. Data collected provides information for predicting trend in 1982-83.

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ROCKY MOUNTAIN

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METHODS

In early September the North Fork drainage was flown in fixed-wing aircraft to delineate infestation boundaries and to aid in selecting appropriate areas for ground sampling.

In each area examined, variable plot sampling (20 BAF) was used to determine green stand structure, and one-tenth acre fixed plots were established to assess tree mortality. Ten combined plots were located at 2- to 3-chain intervals. On each variable plot we recorded live tree species by d.b.h., plus the height of the first tree. On the fixed-radius plots we measured beetle-killed trees, noting d.b.h. and year of kill. Bark beetle brood was sampled by removing two 6- by 6-inch bark samples from opposite sides of newly attacked trees at breast height and recording number of brood by stage/sample. Brood sampling was compared with Knight's (1960) sequential sampling scheme for Engelmann spruce beetle, and aids in forecasting population trend.

RESULTS AND DISCUSSION

Windthrow that occurred in 1979 was sufficient to trigger spruce beetle populations resulting in the present outbreak. Infestation has now developed in mature-overmature spruce stands on 1,950 acres from Big Creek north to Yakinikak drainage.

Infestation ranges from a few small scattered group kills to more than 50 trees/group. Greatest concentrations of infested trees occur in Coal Creek, South Coal Creek, and Upper Red Meadow. Smaller infested pockets were detected in Cyclone, Moran, Hay, Moose, Shorty, Whale, Antley, and Yakinikak drainages.

Stand Composition

Forest vegetation along drainage bottoms is characterized by mixed stands of old growth (250 years) Engelmann spruce and alpine fir in most areas. Mixes of lodgepole pine, Douglas-fir, western larch, and yew were found in other areas. Stands are medium to well stocked; volumes of 20,000-32,000 BF/acre are common. Basal area/acre in stands surveyed is shown in table 1.

Table 1.--Forest vegetation in stands surveyed - Glacier View Ranger District, Flathead National Forest, 1981

Area	Tree species	Live basal area/ac	Dead basal area/ac	Total BA
Coal Creek	Engelmann spruce	76.5	61.6	161.6
	Alpine fir	23.5		
Moran	Engelmann spruce	72.0	120.3	220.3
	Alpine fir	28.0		
Whale Cr.	Engelmann spruce	26.8	31.6	131.6
	Alpine fir	60.8		
	Western larch	4.5		
	Lodgepole pine	2.2		
	Douglas-fir	5.6		
	Yew	0.1		
Big Creek	Engelmann spruce	60.0	66.0	166.0
	Alpine fir	40.0		

Tree mortality by year and percent stand killed is shown in table 2.

Table 2.--Engelmann spruce mortality and percent stand infested North Fork Flathead River drainage, Glacier View Ranger District, Flathead National Forest, 1981.

Area	Trees killed/acre 1979	1980	1981	Total trees killed /acre	% stand killed/yr 1979	1980	1981	Total % killed
Coal Ck.	3.0	7.0	10.0	20	9.4	21.9	31.0	62.3
Moran Ck.	9.0	25.0	3.0	37	14.5	40.3	4.8	59.6
Whale Ck.	5.0	6.0	0	11	33.3	40.0	0	73.3
Big Ck.	10.7	2.0	3.3	16	57.1	10.7	17.9	85.7

Average diameter of infested and residual susceptible spruce is shown in table 3.

Table 3.--Average diameter of infested and residual susceptible spruce, Glacier View Ranger District, Flathead National Forest, 1981.

Item	Coal Ck.	Moran Ck.	Whale Ck.	Big Ck.
1980 infested	18.3	20.2	21.8	27.3
1981 infested	19.9	15.5	-	26.6
Residual green spruce	17.7	15.0	18.6	19.4

The average diameter of spruce infested in 1980 was 21.9 inches d.b.h., and 20.6 inches d.b.h. in 1981. Large diameter spruce have been preferentially selected and diameters of dead spruce are significantly larger than diameters of live spruce remaining in plots surveyed.

Beetle Populations

Brood sampling for hibernating adult beetles in 1980 attacked trees was done too late in the season to make reliable predictions of population-trend using Knight's (1960) sequential sampling plan. Sampling is usually carried out in August and relies on counts of prehibernating adults. By early September most beetles had emerged from beneath the bark and migrated to the tree bases to hibernate. Based on examination of trees infested with hibernating adults sufficient brood (hibernating adults) is present that will emerge next June (1982) resulting in an increase in the number of infested trees. Brood samples (larvae) from trees infested in 1981 average 187/ft^2, and will result in an increase in number of spruce attacked in June 1983. The incidence of parasitism and predation on larval populations was too low to influence population trend. Woodpecker activity was light to heavy but many brood trees were unaffected.

Future Course of Outbreak

Spruce beetles generally attack the largest diameter trees available which favors a high rate of brood survival. As an outbreak progresses toward natural collapse, the average diameter of infested trees declines until the number of pitchouts exceeds the number of trees successfully attacked.

Additional mortality is predicted to occur in all areas since an active beetle population is present and diameters and ages of surviving spruce are contributing to high hazard conditions. Not only is continued mortality predicted in areas with existing infestation, but an expansion of infestation to stands not yet affected is also expected. Enough beetles are present to sustain tree mortality through 1983. Residual stands can be hazard rated using the parameters in table 4.

Table 4.--Hazard rating system for spruce stand for susceptibility to infestation.

Hazard category	Physiographic location	Average d.b.h. of live spruce >10" d.b.h.	Basal area ft^2/acre	Percent spruce in canopy
High	Well drained in creek bottoms Site indexes >120	≥ 16	≥ 150	≥ 65
Medium	Site index 80-120	12-16	100-150	50-65
Low	Site index 40-80	<12	<100	<50

Weather factors may be important in how the outbreak proceeds. Temperatures of -40° F, for 5-7 consecutive days can be lethal to larval populations. The hibernation habit of adults may have evolved in response to cold winter temperatures. When beetles leave the upper bole and re-enter the bark near the base, their survivial is enhanced because under normal conditions 6 feet or more of snow accumulates on the ground in spruce-fir forests and covers the bases of the trees. Below this snow the temperatures are near 32° F, while above the snow line temperatures are colder. Thus, beetles in the bark below the snow line are not subjected to temperatures as cold as those above.

Hibernating adults fly and attack windthrow or standing green trees after temperatures reach 61° F in early summer (Dyer 1973). If temperatures remain near this level throughout the season, beetle flight will be prolonged and tree mortality will be less. However, if temperatures are well above 61° F for 3 or 4 consecutive days, the majority of beetle flight occurs during a few days and substantial tree mortality can be expected (McMullen and Atkins 1962).

MANAGEMENT ALTERNATIVES

Various means of management can be employed against the spruce beetle depending on the areas, values, and management practices involved. These will be discussed briefly since they are treated extensively in the literature (Alexander 1973; Dyer and Safranyik 1977; Schmid and Frye 1976).

Salvage Logging

This involves removing infested trees prior to beetle emergence. Salvage logging can be quite expensive but does provide usable lumber. It is short-term in effectiveness since it does little to modify stand conditions favoring beetle infestations. Spruce with hibernating adults should be removed prior to June 1, 1982. Those with eggs and larvae should be removed prior to June 1, 1983.

Trap Trees

The beetle prefers down material and attacks windthrow, logging residues (more than 12 inches d.b.h.) much heavier than standing trees. A trap tree will absorb about four times the number of beetles as standing trees (Dyer and Safranyik 1977). Trap trees are a commonly used suppression technique and can be used by felling groups of 5-10 trees/acre within an ongoing infestation prior to beetle flight; allow them to be attacked, then remove or treat them. Normally one trap tree is felled for every 4-5 infested standing trees. Trees can be felled in shaded, accessible locations; limbs should be left on, trees shouldn't be bucked and timing is critical. Trap trees felled in the spring (April) are more attractive than those felled during fall months. Trap trees are a good option for areas and stands which cannot be salvage logged prior to beetle flight next June.

Silvicultural Management

Some stands are more susceptible than others and stand characteristics for susceptibility have been identified which provide guidelines for management using a hazard rating system (Schmid & Frye 1976).

Silvicultural prescriptions can be employed to lessen risk by reducing basal area, age class, removing large diameter, individual susceptible trees, and generally improving overall stand vigor. Such "beetle proofing" techniques are the ideal approach and require a commitment to intensive management for timber and other resources.

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